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Botany and Horticulture
at the
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BOTANY AND HORTICULTURE IN HAWAII.

I. Introductory.

Much interest is expressed concerning the College of Hawaii and its manifold relationships to the Territory for whose welfare it exists. This interest pervades the entire community, being most evident among those who are directly or indirectly in touch with the actual teaching work of the institution, and among those who look to the College for tangible results of an investigational and utilitarian nature.

The Territory of Hawaii is distinctive in the agricultural nature of its industries. It is essentially a farming country, although the agriculture is organized upon a peculiarly extensive and corporate basis. Because of the large size of the agricultural enterprises, the subsidiary engineering, manufacturing and transportation industries are concomitantly well developed. The industrial problems of the islands, (excepting those intricate sociological complexes that have as yet been scarcely thought of), can, therefore, be divided into two great groups—those relating to agricultural enterprises, and those relating to the industries comprehended by the broad term engineering.

Botany and Horticulture are two great sciences that integrate with agricultural businesses. The range of the former is that of the gigantic and dominant vegetable kingdom, with its innumerable and diverse forms; the latter being the art and science of certain plants useful to man—fruits, flowers, vegetables, ornamentals. Horticulture is both an art and a science — it applies the profound laws of plant life to the simple processes of the fern-house, the vegetable garden, the vineyard.

II. Botanical Conditions in Hawaii.

Hawaii is unique in the endemic nature of its indigenous flora. No other region of similar area in the world has so large a proportion of peculiar plants. A surprisingly wide range of plant life is comprehended. The great variety of environmental conditions has produced striking series of morphological variations. A group of very interesting problems is furnished in the relations between the development of the flora and the geological development of the Islands. Kauai is richest, botanically, being oldest; Hawaii has a comparatively scant flora.

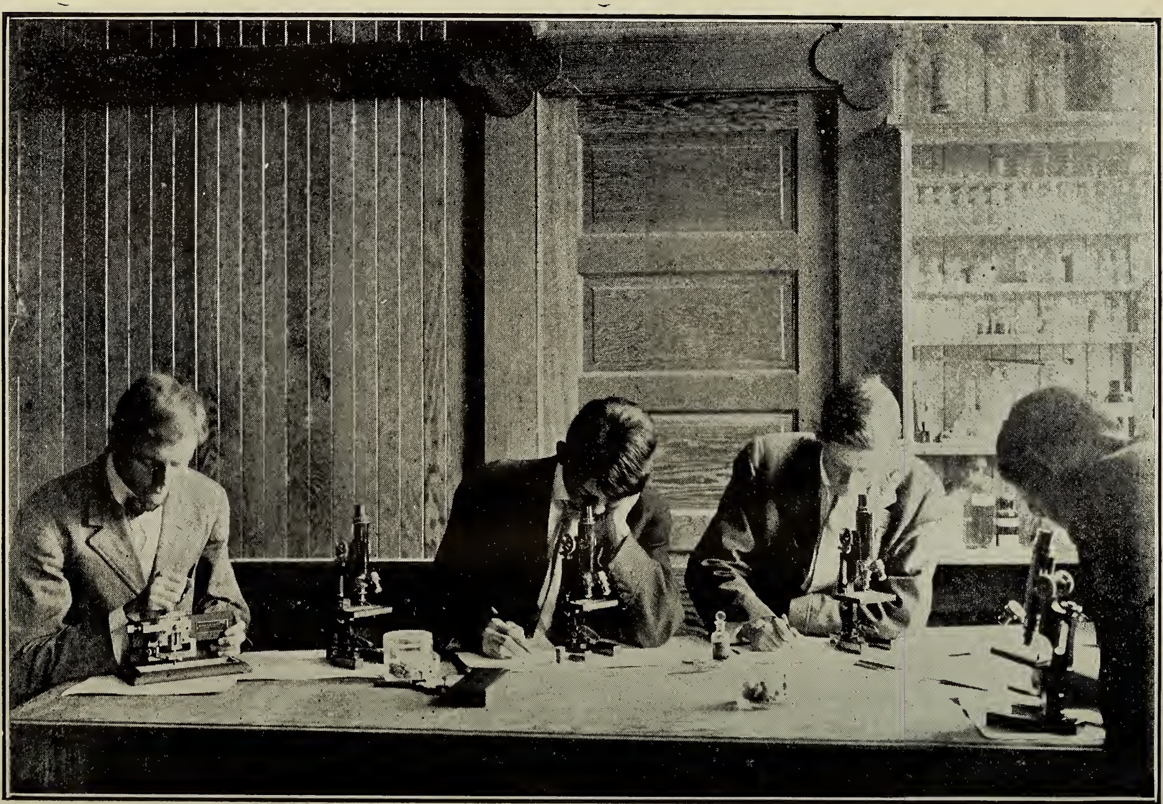

Fig. 1. PORTION OF BOTANICAL LABORATORY, SHOWING CLASS AT WORK.

The zonation of plants offers another striking series of problems. All are familiar with the changes in the vegetation noticed as one travels from the beach up into the mountains. Study has already shown that the various species of plants inhabit more or less definite geographical zones, but these zones of distribution are only partially known.

The life and customs of the ancient Hawaiians is to the botanist a fruitful field for study. The language abounds in picture-words drawn from or relating to the phenomena of plant life. The ancient meles contain many references to important native plants, such as the cocoanut, maile, lehua, milo, etc. Habitations, clothing, canoes, weapons and utensils, vessels and containers, medicines, fibers, and the bulk of the food supply, were all derived from plants. The Hawaiian's relation to the plants of his environment was intimate and minute, and it is very unfortunate that their extensive plant lore has so largely passed into oblivion.

There is not only this rich abundance of indigenous plant life, but also a bewildering variety of introduced plants. These have been brought in from all parts of the world, though chiefly from tropical and temperate regions. Shade and ornamental trees, fruit trees, trees suitable for windbreaks and lumber, are of interest to the dendrologist. There is a great diversity of flowering plants, grasses, ornamental shrubs and vines, vegetables and small fruits, each species being usually represented by a number of varieties. Manifold questions arise as to acclimatization, relations to insects and fungi, structural and physiological modifications due to new environment. The solution of such problems affords the botanist opportunity for the full exercise of his knowledge and ability.

The marine flora deserves special mention. The ancient Hawaiians used as food a great variety of seaweeds (limu), and carried on within the fish ponds a culture of certain species. The zonal distribution of these marine algae has not been studied as yet, and our numerous coral reefs still await detailed biologic investigation. The deep-sea regions immediately adjacent to the islands are, in general, unexplored.

The high mountain flora also merits scientific attention, for, although much of the systematic collecting of the past has been done in these regions, there is little work of an ecological nature. In such marked environments the ecological problems are of paramount interest.

III. Horticultural Conditions in Hawaii.

Hawaii is as unique in its horticulture as in its botany. The ancient Hawaiians had a highly developed intensive system of crop production that, although termed agriculture, was truly horticultural in its principles and practices. This

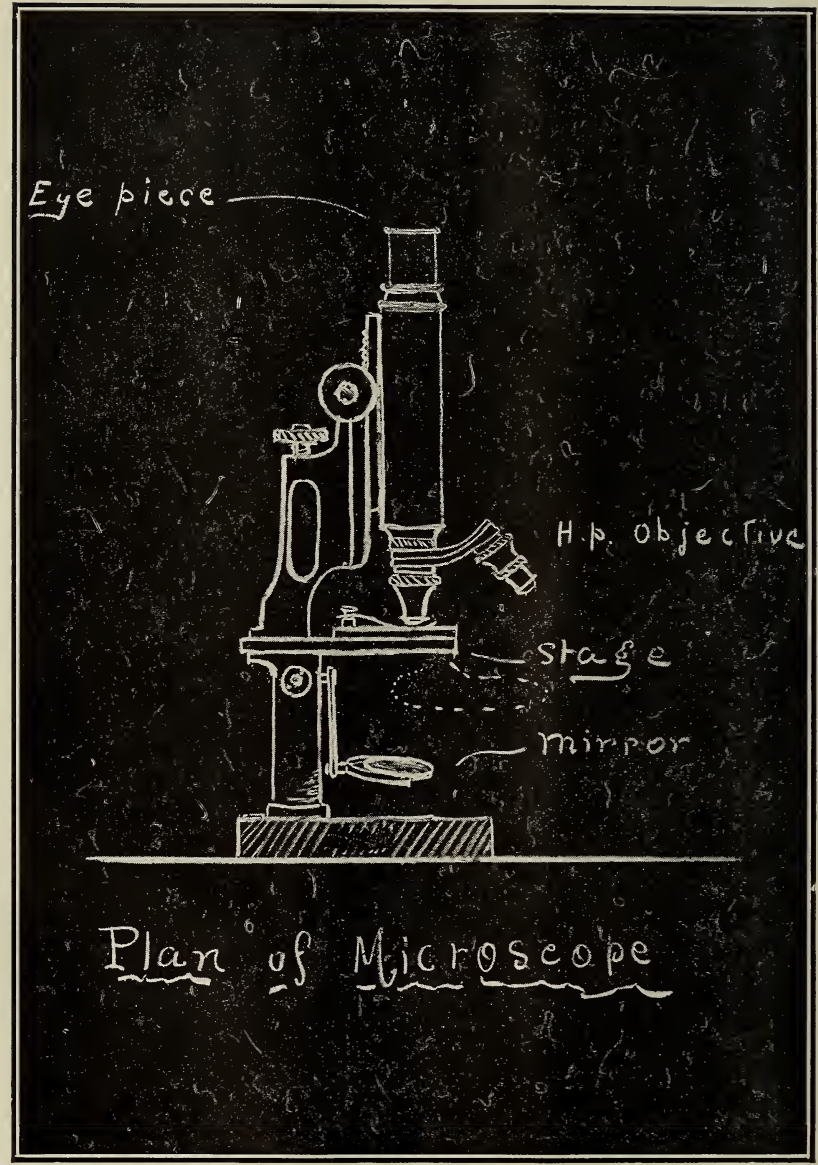

Fig. 2. BLACKBOARD SKETCH OF COMPOUND MICROSCOPE, SHOWING ESSENTIAL PARTS.

is, unfortunately, decadent, and little survives but deserted taro patches, neglected groves of bananas, and slow dying cocoanut plantations, to tell of its extent and marvelous adaptation to local conditions. From all that can be learned at the present time, the ancient practices were highly commendable. Arable land and available water was utilized to a maximum degree. The Hawaiian, moreover, as has been already suggested, had a minute and exact knowledge of the varieties of food crops (ex. taro, sweet potatoes, bananas, etc.) and their cultural requirements. Much of this old knowledge could be profitably revived.

For example, the poor quality of the "Hawaiian" sweet potatoes commonly sold in the Honolulu markets is notorious, yet there are many delicious native varieties, some almost fruit-like in their fineness of texture and flavor.

Another profitable field for investigation is a study of the horticultural methods employed by the various nationalities that have come into the Territory. The generally-acknowledged skill of the Portuguese in raising grapes and figs; the ability that the Chinese vegetable gardener shows in exacting the utmost tribute from his land; the magic touch of the laborious Japanese, whereby mountain slopes, old taro patches, and erstwhile vacant lots blossom with a thousand fragrant flowers; all these are worthy of scientific study, for these peoples have solved many distinctly local horticultural problems.

The fruits which are now of commercial importance are pineapples, bananas (Chinese and Jamaica), avocados, and cocoanuts. Each of these needs much study to the end that they may be definitely adapted to Hawaiian conditions.

IV. Functions of the Department.

The above survey of local conditions reveals some of the many gaps in our knowledge of Hawaiian botany and horticulture. The functions of the Department of Botany and Horticulture are, of course, primarily to give cultural and practical training through the subject-matter comprehended by the title used. It also conducts research studies in these subjects, and presents facilities for graduate work therein.

Note that the primary function of the department is *training*. The keynote of the best education of today is The Ability to Do. All learning should result in the power to think correctly and to act wisely and skilfully. The training is gotten through specific contact with certain subject-matter. The young man who has taken a course in general botany should be able to scientifically attack a practical problem of plant life, and to arrive at certain verified conclusions, upon which definite action could be profitably based. This ability is the

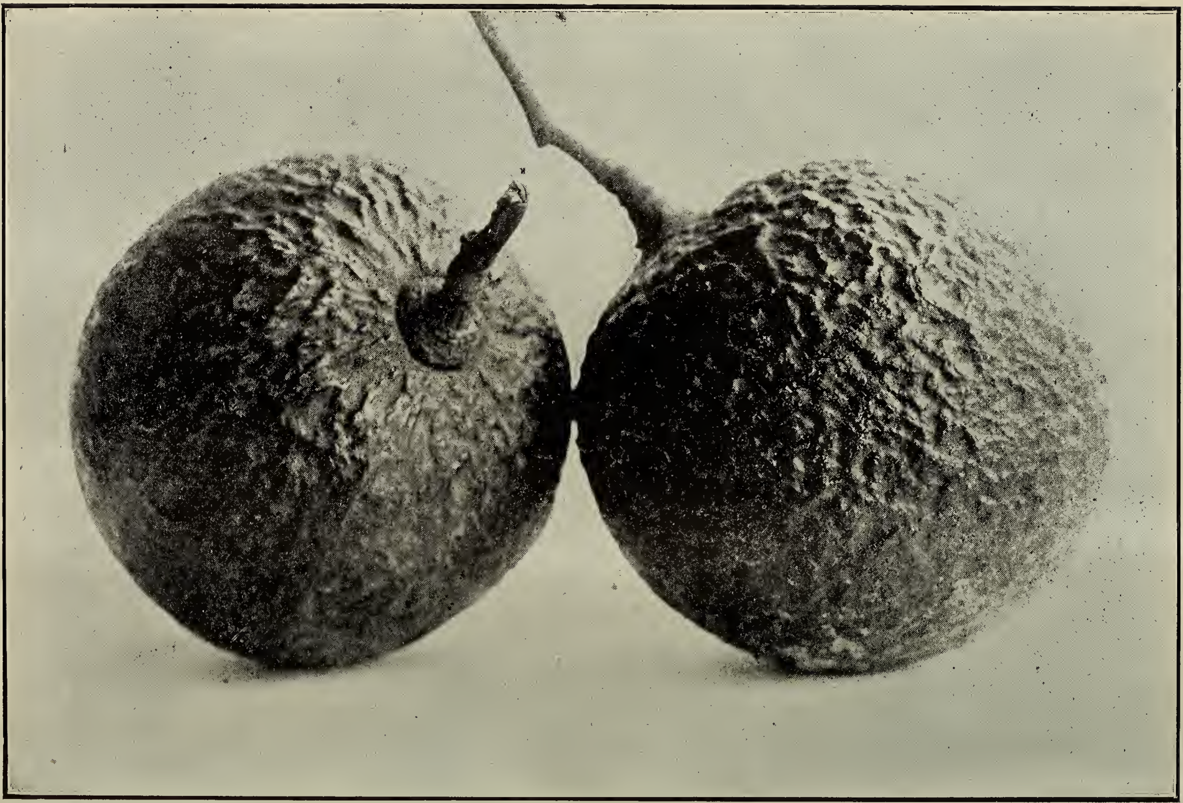

Fig. 3. A "HARD-SHELLED" VARIETY OF PERSEA AVOCADO, ESPECIALLY ADAPTED FOR LONG DISTANCE SHIPPING.

real test of education, and is the final demarcation between the civilized man and the savage. The attending of lectures, the participating in class discussions, the studying of the text-book and of reference-books, the performing of specific field and laboratory exercises—all these have as their pivotal point—their vital essence—the definite Training to Do. This Education for Service—the pith and strength of modern collegiate teaching, is often unnoticed by the casual observer of pedagogic methods.

V. The Courses.

The Department offers four regular courses in Botany, and three in Horticulture.

Each course is presented from a twofold viewpoint—first, the fundamental principles of the subject; second, the applications of these principles, especially as exemplified in Hawaii, and in similar tropical and subtropical countries. The courses are as follows:—

1. The Morphology and Physiology of Plants.
2. Systematic Botany.
3. Dendrology.
4. Elementary Bacteriology.
5. General Horticulture.
6. The Propagation of Plants.
7. Tropical and Subtropical Fruits.

VI. Equipment.

The equipment of the Department includes a lecture room seating fifty, standard laboratory apparatus and supplies (Fig. 1), a stereopticon, wall charts, collections of lantern slides, photographs, models and other illustrative material. The library is carefuly chosen, and includes standard periodicals.

Two herbaria are gradually developing—one of typical species illustrating the Hawaiian flora, for taxonomic work; the other is a garden herbarium, to contain the species and varieties of cultivated plants.

The microscopical equipment is thorough and of the best quality, affording opportunity for advanced histological, pathological, and embryological work.

The Department has a very good set of field instruments, including photographic equipment, for use in botanical and biological survey work.

The engineering laboratory has a high-grade materials-testing department, and its work in timber-testing articulates with the course in dendrology.

VII. Lectures.

The point-of-view of the lectures has already been stated. Carefully-prepared lecture notes are required in all courses. They contain the lecture outlines, references, illustrative drawings (Fig. 2), etc. Study-guides are issued for each lecture, giving topical questions, assignments, references, and other aids to individual work. These notes are preserved and bound, forming a readily accessible digest of the subject-matter covered.

VIII. Laboratory and Field Work.

This work is a fundamental part of all courses. Carefully-made note-books are required, as credit is based to a considerable extent upon this work. A considerable portion of this work is afield, carried on out of doors. This field work is possible throughout the entire year, under especially extensive and satisfying conditions. There is, in the immediate vicinity of Honolulu, a remarkable variety of plant life, both indigenous and exotic; diversified horticultural industries; and several types of forest land.

The work for each laboratory exercise is outlined in a study-guide, similar to those accompanying the lectures. The Department is favored by the coöperation of several other scientific institutions in the city, to which places excursions are made on suitable occasions.

Field trips extending over periods of several days, and having as their purpose detailed biologic surveys of typical regions, will be organized from time to time.

IX. Recitations.

Ability to discuss intelligently the important topics of the course is required. This ability is of distinctive value, and is graded accordingly. Recitation work is based upon the other work of the course. Training is given in the correct oral presentation of well outlined subject-matter.

X. Library Reference Work.

In all courses occasional assignments of reference work are made. Such assignments require thoroughness and accuracy, and presentation in appropriate form. From time to time students are asked to present the results of their special assignments orally to the class concerned. Much of this work deals directly with Hawaiian conditions, thus closely relating the general subject-matter of the course to the peculiar problems of this Territory.

XI. Credit.

Grading is based upon—attendance, status of note-books, recitations and examinations; status of special assignments and collections; general deportment and attitude toward the work. Credit is not given for incomplete work. Tardy work is graded accordingly. All examinations must be taken. Credit for special work, and permission to take courses without credit, is arranged for by consultation.

XII. Special Work.

Students registered in any courses (except Botany 1 and 2, and Horticulture 1), may elect special subjects or problems as a part of their laboratory work. This choice is granted only to students in good standing, who show sufficient preparation and ability to advantageously carry on studies of an investigational nature.

XIII. Research Work.

In addition to its teaching functions, the Department investigates problems of specific interest and value.

An extensive study has been made of the various methods of preparing, staining, and otherwise treating woods for interior finishing, cabinet work, etc. A collection of such woods was made, samples were treated with various combinations of fillers, stains, polishes, varnishes, etc. Records were kept, and photographs made, and certain conclusions reached.

The preserving of fine fruits for exhibition purpose has been a largely unsolved problem for Hawaii. The Department has been, and is now, conducting a series of experiments to determine the proper preservatives for each kind of island fruit. It is a well-known fact among exhibitors that a liquid suitable, for example, for preserving tomatoes, will not be satisfactory for pineapples. The proper mixture must be determined empirically for each species. This is a laborious task, but when the formula is once attained, that particular problem is definitely solved. There are many calls from the mainland for exhibits of Hawaiian fruits, and the value of this work is potent. The Promotion Committee has kindly assisted in this investigation by the loan of certain exhibition glassware.

Nearly every yard in Honolulu has one or more palm trees therein—there are some seventy species in Hawaii—and yet very few people know the correct names of the palms. So a botanical survey is being made of the palms of Hawaii—photographs taken of the different species, literature searched, and material gathered, which will finally be printed, and thus made available for general use.

A survey of the vegetable garden industry in Hawaii is now in progress. Varieties of vegetables, soil and cultural conditions, transportation and marketing will be studied, and much valuable data is anticipated.

XIV. Graduate Work.

The Department is still so young that the offering of postgraduate work is chiefly a matter of the future. There are, however, facilities for individual research and investigation, and these opportunities are open to any who show ability to undertake work of an advanced character, and who have a bona fide purpose therein.

There are, as has already been shown, a great variety of unsolved local botanical and horticultural problems, well worth the attention of students and practical men. One kind of avocado, for example, has a very thick, leathery skin (Fig. 3), admirably adapting it for long-distance shipping. A careful study of this variety would doubtless result in valuable knowledge of distinct financial importance.

XV. The Morphology and Physiology of Plants.

This course consists of lectures, laboratory and field work. recitations, and library reference work. It is given in the first semester, and counts three credits. It is required of Science, Agriculture, and Household Economics Freshmen. This course, with course 2, covers the fundamental principles of general botany. It includes detailed studies of the shoot, leaves, root, structure and ontogeny of the plant cell, primary and secondary tissues, development of internal structure, the general conditions of plant life, and the great processes of nutrition, respiration, growth, movement, and reproduction.

The text required is Principles of Botany, by Bergan, and Davis, Strasburger, Kerner and Oliver. Coulter, and Beasey are the chief reference works. The laboratory exercises involve the use of simple and compound microscopes, performance of selected experiments, and formation of herbaria. Field work includes morphologic observations, and studies of plants in relation to environments.

XVI. Systematic Botany.

This course is organized in the same manner as Course 1. The same text-book is used. It is given in the second semester, and counts three credits. Required of Science, Agriculture, and Household Economics Freshmen.

A careful survey is made of the chief plant groups, with individual studies of distinctive types, and of plant evolution.

Special emphasis upon the flora of the Hawaiian Islands, and upon ecological and economic aspects. Each student makes a herbarium of typical plants for use in taxonomic work. Laboratory exercises upon selected types, and including the preparation of simple keys. Studies of representative plant societies, with field excursions. Reference books—Hillebrand, Engler and Prouth, and various tropical floras.

XVII. Dendrology.

Lectures, laboratory and field work, recitations, and library reference work. This course is given in the first semester, and counts two credits. Required of C. E. Seniors. A survey of the morphology and histological structure, classification, life histories, diseases and enemies of timber trees, from the standpoint of Hawaiian and North American forest conditions. Detailed studies of wood structure as affecting its uses in structural engineering, furniture making, interior finishing, paper and other pulp products. The physical, mechanical, and chemical properties of woods. Laboratory exercises upon the important trees of Hawaii, and of the world. Students will prepare keys to common woods. Excursions are made to several forest regions of Oahu, to timber-testing plants, lumber yards, mills, and forest nurseries. A thesis upon some important timber tree is required. Collections are made of wood samples and various forest products. Books chiefly used are: Publications of the National and Territorial Bureaus of Forestry; Gifford, Practical Forestry; Sargent, Manual of the Trees of N. A.; Brandis, Indian Trees.

XVIII. Elementary Bacteriology.

Lectures, recitations, laboratory and library work. Given in the first semester and counts three credits. Required of Science, Agriculture, C. E., and Household Economics Juniors. A resumé of the general field of bacteriology, emphasizing economic features, especially in relation to agricultural processes, and to public health. The laboratory work is organized to give training in standard methods of procedure, and studies of type forms. Each student prepares a set of slides illustrating representative micro organisms. Excursions are made to the laboratories in the city. Books chiefly used: Williams, Moore, Sternberg, Lehmann and Neumann, Conn, MacFarland, Eyre.

XIX. General Horticulture.

Lectures, laboratory and field work, recitations, and library reference work. First semester, counting three credits. Required of Agriculture Juniors. A careful study of the principles of horticulture, especially as exemplified by the best practices in the United States mainland, in Hawaii and in Europe. The fundamental methods of fruit growing, vegetable gardening, floriculture, and landscape gardening. A study of local horticultural conditions, from the standpoint of the amateur, and of the commercial grower. Excursions to local regions of horticultural interest,—orchards, vegetable and flower gardens, fern houses, nurseries, parks, private estates, etc. Books chiefly used: Bailey, Principles of Fruit Growing, of Vegetable Gardening, Taft, Greenhouse Management; Maynard, Landscape Gardening; Bailey, Cyclopedia of American Horticulture.

XX. The Propagation of Plants.

Organization is the same as XIX. Second semester, counting three credits. Required of Agriculture Sophomores. A comprehensive study of the principles of plant production, and of those methods most applicable to the important fruits, flowers, and vegetables of Hawaii. A survey of the standard methods used in other horticultural regions. A special study of plant selection and breeding. Laboratory exercises in seed selection and testing, hybridization, care and planting of seeds, separation, division, layering, cuttage, budding and grafting. Occasional excursions to orchards, nurseries and similar localities. Text: Bailey, Nursery Book.

XXI. Tropical and Subtropical Fruits.

Lectures, laboratory and field exercises, recitations, and library reference work. Second semester, counting three credits. Required of Agriculture Juniors. A systematic study of important fruits,—description, distribution, varieties, propagation, planting, culture, fertilizing, spraying, harvesting, grading, packing, marketing and other commercial aspects. The fruits thus studied are: Pineapple; citrus fruits; grape; banana; apricot; peach; nectarine; mango; avacado; papaia; fig; date; olive; coconut and other tropical nuts; anonas; eugenias; breadfruit. General studies are made of fruit protection, processing, preservation, utilization of wastes. Laboratory studies of important species and varities, with reference to botanical status, adaptations and commercial value. The preparation and application of standard spray mixtures. Excursions to fruit farms, orchards, canning factories, warehouses, etc. Text: Wickson, Fruits of California.

Through these channels the Department of Botany and Horticulture strives to meet the needs of the Territory of Hawaii,—growing needs, whose importance increases year by year.

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